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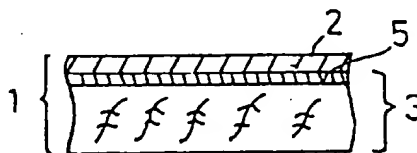
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(54) **Process for producing a stencil printing sheet**

(57) A process for producing a stencil printing sheet  
comprising the steps of coating a surface of a solvent-  
soluble resin film with a solvent which dissolves said  
solvent-soluble resin film, superposing a porous sub-

strate on the coated surface of said solvent-soluble  
resin film, and drying to adhere said solvent-soluble  
resin film to said porous substrate.

**FIG. 2**



## Description

The present invention relates to a process for producing a stencil printing sheet. Specifically, the present invention relates to a process for producing a stencil printing sheet having a solvent-soluble resin layer.

In the prior art, a heat-sensitive stencil sheet is known which is produced by laminating a thermoplastic resin film onto a porous substrate with an adhesive. Stencil-making of this heat-sensitive stencil sheet is, for example, carried out by means of (1) a process of superposing a hand written or preliminarily prepared manuscript onto the heat-sensitive stencil sheet and then perforating by melting the thermoplastic resin film using the heat generated from, for example, a flash lamp or an infrared lamp (see for example US-A-4628813), and (2) a process of bringing a thermal head which generates dot-like heat zones, in accordance with electrical signals from letter or picture information, into contact with the heat-sensitive stencil sheet, and perforating by melting the thermoplastic resin film (see for example US-A-4568951).

However, the stencil-making processes described above require a complicated process of bringing either a manuscript heated by irradiated light or a thermal head into contact with a heat-sensitive stencil sheet, conducting the heat to the thermoplastic resin film of the heat-sensitive stencil sheet to melt the thermoplastic resin film and then shrinking the molten material to perforate the thermoplastic resin film. These stencil-making processes have the disadvantages that, for example, (1) a perforating failure is produced on contact failure between a thermoplastic resin film and either a manuscript which has absorbed heat or a thermal head; (2) a perforating failure is produced by nonuniformity in the applied pressure of a thermal head, resulting in wrinkles in a heat-sensitive stencil sheet; (3) the molten material of a thermoplastic resin film adheres to a thermal head, resulting in a conveying failure of a heat-sensitive stencil sheet; and (4) since the molten material is left in a perforated portion, ink permeability is prevented, resulting in printing failure.

EP-A-0108509 discloses a process for producing a stencil printing sheet in which the acid in an acid solution (stencil-making solution) reacts with a water-insoluble polymer (a masking film) to provide a water-soluble product, which product is removed by water or a water-soluble liquid to obtain a perforated stencil sheet.

In recent years, a further improvement in the quality of heat-sensitive stencil sheet has been demanded. A heat-sensitive stencil sheet is required which satisfies the smoothness of the thermoplastic resin film, the separating property of the thermoplastic resin film from the manuscript or thermal head, the melting property due to heat, the shrinkability of the thermoplastic resin film, the adhesive strength between the thermoplastic resin film and the porous substrate, and the mechanical strength and abrasion strength of the porous substrate. In order to achieve such a heat-sensitive stencil sheet the process of producing the heat-sensitive stencil sheet has become more complicated leading to increased production cost.

It is a main aim of this invention to solve the above-mentioned problems in the prior art and provide a process for producing a stencil printing sheet in which the production process is easy, the production cost can be lowered and there is no perforating failure at the time of stencil-making, no generation of wrinkles, no conveying failure and no printing failure.

Accordingly, the present invention provides a process for producing a stencil printing sheet comprising the steps of coating a surface of a solvent-soluble resin film with a solvent which dissolves said solvent-soluble resin film, superposing a porous substrate on the coated surface of said solvent-soluble resin film, and drying to adhere said solvent-soluble resin film to said porous substrate.

Preferred embodiments of the present invention will be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a sectional explanatory view showing a stencil printing sheet produced in Example 1;

Figure 2 is a sectional explanatory view showing a stencil printing sheet produced in Example 4;

Figure 3 is an explanatory view showing the production of the stencil printing sheet in Example 5; and

Figure 4 is an explanatory view showing the perforation of the stencil printing sheet produced in Example 5.

A solvent-soluble resin film to be used in this invention contains a thermoplastic or thermosetting resin soluble in water or an organic solvent as a main component.

As a resin soluble in an organic solvent, polyethylene, polypropylene, polyisobutylene, polystyrene, polyvinyl chloride, polyvinylidene chloride, polyvinyl fluoride, polyvinyl acetate, acrylic resin, polyamide, polyimide, polyester, polycarbonate and polyurethane may, for example, be used. These resins may be used independently or in admixture. Copolymerized forms of these resins may also be used.

As a water-soluble resin, a resin soluble in water or in a water-miscible organic solvent, such as polyvinyl alcohol, methyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyvinyl pyrrolidone, polyethylene-polyvinyl alcohol copolymer, polyethylene oxide, polyvinyl ether, polyvinyl acetal and polyacrylamide may, for example, be used. These resins may be used independently or in admixture. Copolymerized forms of these resins may also be used.

In addition to the above resin components, dyestuffs, pigments, fillers, binders and hardeners can be also contained in the solvent-soluble resin film described above.

The thickness of the solvent-soluble resin film is preferably in the range of from 0.1  $\mu\text{m}$  to 100  $\mu\text{m}$ , and more preferably in the range of from 1  $\mu\text{m}$  to 50  $\mu\text{m}$ . When the thickness of the resin film is less than 0.1  $\mu\text{m}$  the strength of the resin film becomes insufficient, and when the thickness of the resin film exceeds 100  $\mu\text{m}$  a large quantity of solvent for dissolving the resin film may be required and the dissolution of the resin film often becomes insufficient.

As a porous substrate to be used in the invention, Japanese paper, woven or nonwoven cloth, gauze made from natural fiber such as Manila hemp, pulp, Mitsumata (*Edgeworthia papyrifera* Sieb.), Kozo (*Broussonetia kazinoki* Sieb.), synthetic fiber such as polyester, nylon, vinylon or acetate fiber, a thin leaf paper using metallic fiber or glass fiber, independently or in combination, are examples. The basis weight of these porous substrates is preferably in the range of from 1  $\text{g/m}^2$  to 20  $\text{g/m}^2$ , and more preferably in the range of from 5  $\text{g/m}^2$  to 15  $\text{g/m}^2$ . When the basis weight is less than 1  $\text{g/m}^2$  the strength of the sheet is poor, and when the basis weight exceeds 20  $\text{g/m}^2$  ink permeability is often poor at the time of printing. Also, the thickness of the porous substrate is preferably in the range of from 5  $\mu\text{m}$  to 100  $\mu\text{m}$ , and more preferably in the range of from 10  $\mu\text{m}$  to 50  $\mu\text{m}$ . When the thickness is less than 5  $\mu\text{m}$  the strength of the sheet is poor, and when the thickness exceeds 100  $\mu\text{m}$  ink permeability is often poor at the time of printing.

For laminating the solvent-soluble resin film to the porous substrate, a process of coating the resin film with a solvent which dissolves the resin film, superposing a porous substrate on the coated surface, and drying the superposed surface, is employed.

This process makes use of the characteristics of a solvent-soluble resin film which dissolves in a solvent. Since the dissolved surface of the resin film has an adhesive function, the process is simple and the production cost can be reduced. As a solvent, a solvent that dissolves the resin film which will be described later may be used. This solvent is coated wholly or partially on one major surface of the resin film. Then, a porous substrate is superposed to this surface and the superposed surface is dried, resulting in lamination.

Since the stencil printing sheet produced by the above process has a solvent-soluble resin film, once the resin film is brought into contact with a solvent which dissolves the resin film, the resin component in the contacted portion starts dissolving into the solvent and continues to dissolve in the solvent up to its solubility limit. The solution containing dissolved resin permeates into the porous substrate and the resin film corresponding to this portion is perforated. Since the solution containing dissolved resin permeates into the porous substrate, the dissolved component is not left in the perforated portion of the resin film and does not obstruct the perforation. In addition, the perforating property of the resin film can be adjusted by controlling the relative solubility of the solvent to the resin film and the quantity of the contacting solvent.

As a solvent which dissolves the solvent-soluble resin film, aliphatic hydrocarbons, aromatic hydrocarbons, alcohols, ketones, esters, ethers, aldehydes, carboxylic acids, carboxylic esters, amines, low molecular heterocyclic compounds, oxides and water are examples. Specifically, hexane, heptane, octane, benzene, toluene, xylene, methyl alcohol, ethyl alcohol, isopropyl alcohol, n-propyl alcohol, butyl alcohol, ethylene glycol, diethylene glycol, propylene glycol, glycerine, acetone, methyl ethyl ketone, ethyl acetate, propyl acetate, ethyl ether, tetrahydrofuran, 1,4-dioxane, formic acid, acetic acid, propionic acid, formaldehyde, acetaldehyde, methylamine, ethylenediamine, dimethylformamide, pyridine and ethylene oxide are preferred. These solvents can be used independently or in admixture. Furthermore, dyestuffs, pigments, fillers, binders, hardeners, antiseptics, wetting agents, surfactants and pH conditioners can be included in the solvent.

The stencil-making of the stencil printing sheet described above may be carried out by bringing a means, such as a brush pen soaked in a solvent, into contact with the solvent-soluble resin film directly, but it is preferable to feed the solvent to the resin film by a solvent ejecting device in a non-contact condition.

Examples of a solvent ejecting device are a nozzle, a slit, an injector, a porous material and a porous film connected to a liquid feed pump, a piezoelectric element or a heating element so as to release the solvent intermittently or continuously in dot or line form corresponding to each letter and picture signal. Since this kind of process makes it possible to carry out the stencil-making of stencil printing sheet in a non-contact condition, there is no generation of wrinkles at the time of stencil-making. Also, differently from a conventional heat-sensitive stencil sheet, no molten material is left in the perforated portion and a brilliant printed matter can be obtained.

Furthermore, the stencil printing sheet of the invention can be produced without need of a specific separating property, abrasion strength or mechanical strength as required in a conventional heat-sensitive stencil sheet.

The stencil printing sheet obtained by the process of the invention can be applied to a general stencil printing process to obtain printed matter. For example, printed matter can be obtained by providing ink on a perforated stencil printing sheet, passing the ink through each perforated portion by press rolls, reduced pressure means or squeegee rolls, and transcribing the ink to a printing paper. As a printing ink, an oily ink usually used in stencil printing, water-based ink, water-in-oil emulsion ink or oil-in-water emulsion ink can be used.

Examples of stencil printing processes are given below.

#### Example 1

An adhesive solution having the following composition was coated on a polyester fiber cloth having a sieve opening

of 200 mesh and dried. Then, a polyvinyl alcohol film of 10  $\mu\text{m}$  in thickness was superposed on this coated surface and left in a thermostat at 40 °C for two days to give a stencil printing sheet. A sectional view of the stencil printing sheet is shown in Figure 1, wherein reference sign 1 indicates a stencil printing sheet, reference sign 2 indicates a polyvinyl alcohol film (solvent-soluble resin film), reference sign 3 indicates a polyester fiber cloth (porous substrate), and reference sign 4 indicates an adhesive soaked in the porous substrate.

Polyurethane (solid content 30% by weight)	50 parts by weight
Isocyanate	5 parts by weight
Ethyl acetate	25 parts by weight
Toluene	20 parts by weight

An aqueous solution having the following composition was ejected in a letter shape onto the stencil printing sheet described above from an ejecting means provided with a nozzle of 8 dots/mm and a piezoelectric element connected thereto. The polyvinyl alcohol film at the ejected portion was dissolved and perforated.

Isopropyl alcohol	20 parts by weight
Ethylene glycol	10 parts by weight
Water	70 parts by weight

Then, a black offset ink was provided on the polyester fiber cloth of the perforated stencil printing sheet, and this sheet was superposed on a printing paper. When the ink was squeezed by a blade, letters similar to those shown in the perforated portions were brilliantly printed.

#### Example 2

An adhesive solution having the following composition was coated on a polyester fiber cloth having a sieve opening of 200 mesh and dried. Then, a polycarbonate film of 6  $\mu\text{m}$  in thickness was superposed on this coated surface to give a stencil printing sheet.

Acrylic emulsion adhesive (solid content 50% by weight)	50 parts by weight
Water	50 parts by weight

A solvent mixture having the following composition was ejected in a letter shape onto the stencil printing sheet described above using an ejecting means in the manner of Example 1. The polycarbonate film in the ejected portion was dissolved and perforated.

Methyl ethyl ketone	50 parts by weight
Toluene	30 parts by weight
Isopropyl alcohol	20 parts by weight

Subsequently, a black ink (HI-MESH, trade mark of Riso Kagaku Corporation) for use in a portable stencil printing device (PRINT GOKKO PG-10, trade mark of Riso Kagaku Corporation) was provided on the polyester fiber cloth of the perforated stencil printing sheet, and this cloth was superposed on a printing paper to carry out printing by means of PRINT GOKKO PG-10, resulting in the printing of brilliant letters similar to those of the perforated portions.

## Example 3

The same resin solution as used in Example 2 was coated on a Japanese paper having a basis weight of 10 g/m<sup>2</sup> and dried. Then, a polyethylene oxide film of 15 µm in thickness was superposed on this surface to give a stencil printing sheet.

In the same manner as in Example 1, stencil-making was carried out on this stencil printing sheet and printing performed, resulting in the printing of good printed matter.

## Example 4

The aqueous solution used in the stencil-making of Example 1 was coated on a polyethylene oxide film of 15 µm in thickness, and a Japanese paper having a basis weight of 10 g/m<sup>2</sup> was superposed on this coated film before that solution was dried. Then, the superposed film was dried to give a stencil printing sheet. A section of the stencil printing sheet thus obtained is shown in Figure 2. In the drawings, reference sign 5 indicates a resin film component dissolved and soaked in the surface of a porous substrate.

The aqueous solution used in the stencil-making of Example 1 was ejected in a letter shape onto this stencil printing sheet from an ejecting means provided with a nozzle of 12 dots/mm and a heating element. The polyethylene oxide film at the ejected portion was dissolved and perforated.

Then, a black offset ink was provided on the polyester fiber cloth of the perforated stencil printing sheet and this was superposed on a printing paper. When the ink was squeezed by a blade, letters similar to those of the perforated portion were brilliantly printed.

## Example 5

A polyvinyl ether film of 20 µm in thickness was laminated to a Japanese paper having a basis weight of 10 g/m<sup>2</sup> by superposing and passing the same through heat rollers at 120°C to give a stencil printing sheet.

In the same manner as in Example 4, stencil-making of this stencil printing sheet was carried out and printing performed, resulting in the printing of good printed matter. An explanatory view showing the production of the stencil printing sheet is given in Figure 3 and an explanatory view showing the perforation is given in Figure 4. In the drawings, reference sign 6 indicates heat rollers, reference signs 7 and 8 indicate solvents, reference sign 9 indicates a resin solution soaked in a porous substrate, reference sign 10 indicates a perforated portion and reference sign 11 indicates an ejecting means.

According to the production process of the invention, as a solvent-soluble resin film is laminated directly to a porous substrate, the production cost can be reduced. Further, the stencil printing sheet obtained by the production process of the invention can be perforated by a solvent in a non-contact condition. In this way there will be no perforating failure at the time of stencil-making, and no wrinkling or conveying failure; and it is possible to print brilliant pictures thereby.

## Claims

1. A process for producing a stencil printing sheet comprising the steps of:

coating a surface of a solvent-soluble resin film with a solvent which dissolves said solvent-soluble resin film; superposing a porous substrate on the coated surface of said solvent-soluble resin film; and drying to adhere said solvent-soluble resin film to said porous substrate.

2. A process for producing a stencil printing sheet according to claim 1, wherein said solvent-soluble resin is selected from polyvinyl alcohol, polycarbonate, polyethylene oxide and polyvinyl ether, polyvinyl acetal, polyurethane, acrylic resin and polyester.

3. A process for producing a stencil printing sheet according to claim 1, wherein said solvent-soluble resin film has a thickness in the range of from 0.1 to 100 µm.

4. A process for producing a stencil printing sheet according to claim 1, wherein said porous substrate is selected from a polyester fiber cloth or a Japanese paper having a basis weight in the range of from 1 to 20 g/m<sup>2</sup> and a thickness in the range of from 5 to 100 µm.

FIG. 1

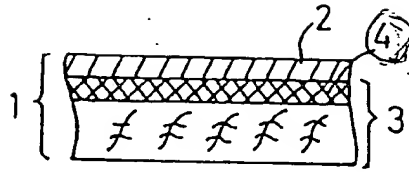


FIG. 2

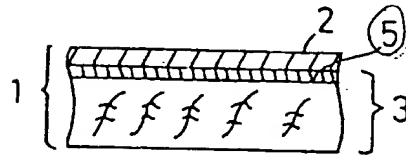


FIG. 3

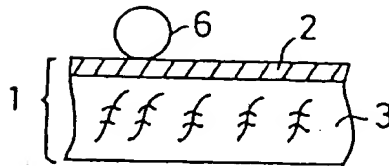


FIG. 4

